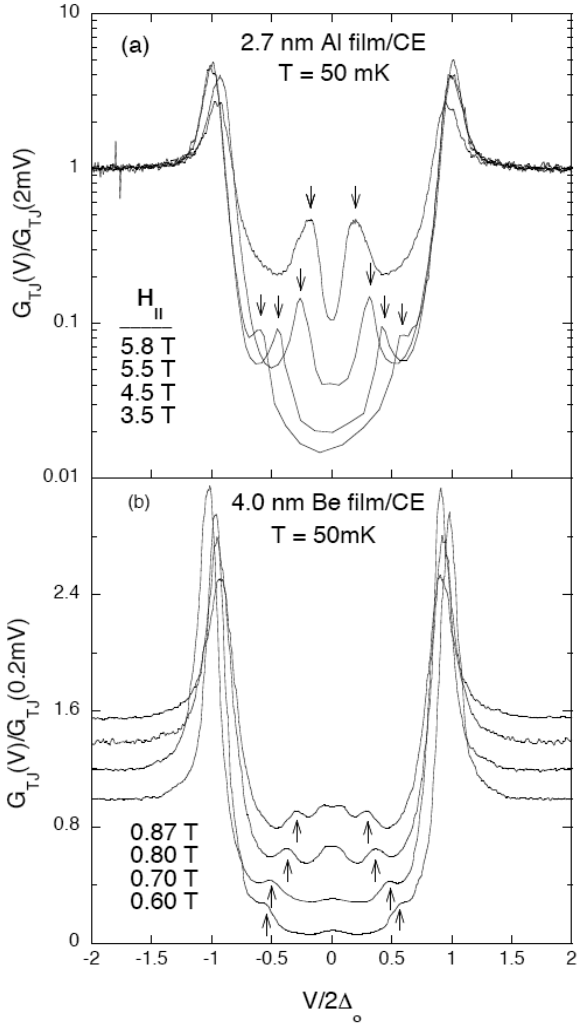
Field Induced Spin Mixing in Ultra-Thin Superconducting Films

Philip W. Adams, Louisiana State University, DMR 02-04871

We have performed a series of experiments investigating the spin states of superconducting Be and Al films in high parallel magnetic fields. Using electron tunneling we show that the electron spins of these "garden variety" superconductors evolve from state where they are exactly pair-wise anti-aligned, to a more complex mixed-spin state as the strength of the magnetic field is increased. This effect can be seen as a small feature in the tunneling spectra that grows rapidly as the critical field is approached, see arrows. We believe that this spin mixing is the result of fluctuations into a long conjectured exotic form of superconductivity known as FFLO.



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Education

We have had a number of undergraduates contribute to the project over the last couple of years. David Craig and Andrew Morse were instrumental in upgrading our electron-beam deposition system, and have gained extensive laboratory experience. In addition, Dr. Xiao-Song Wu, joined my group 6 months ago as a post-doctoral associate, and is currently working on the next series of experiments investigating the evolution of superconducting spin states in high magnetic fields.

Societal Impact

Our research interests have mainly been focused on low dimensional systems that can be treated as being almost ideal. The ultimate goal of the program is to explore the quantum characteristics of well characterized systems, such as the thin aluminum and beryllium films, in extreme environments in order to gain a deeper understanding of the physics of more complex and applicable materials. Our work not only has impact on the condensed matter knowledge base, but also provides an important technological training ground for students and postdocs.